Welding Basics
FACT SHEET

As you begin your journey as a welder, know that making a good weld takes practice. There are a lot of tips and tricks that you will acquire along the way. This lesson will give you the five basic essentials to making a good weld. Think about these before and during a weld, and then reflect on them while inspecting your weld bead. These five basics are historically taught for SMAW welding, but certainly apply to GMAW as well.

Five Basics

1. Heat (settings)
2. Distance (arc length/wire stick-out)
3. Angle (work and travel)
4. Speed (travel speed)
5. Manipulation

Welder Heat Settings

How a welder is set is imperative to a good weld
Observe welder settings charts based on material thickness, electrode type, and electrode diameter
GMAW welders use volts and wire feed speed settings

GMAW Settings

- Set GMAW welders based on base metal thickness, diameter of the electrode, and the joint position
- When performing short circuit GMAW, there should be an even popping or crackling sound, like the sound of bacon frying
- Voltage controls the height and width of the weld bead
- Wire feed speed is associated with amperage and controls the depth of penetration
- Volts and wire speed need a good balance between them in order to obtain a good weld
- Excessive spatter indicates an imbalance of these settings
- If the weld bead is too high and ropey, increase voltage
- If there is undercut and spatter, decrease voltage
- If the weld bead is too small or lacks penetration, increase wire speed
- If the weld bead is oversized and there is overlap, decrease wire speed

Distance

- Distance refers to the arc length while welding
- With GMAW, this can mean the distance from the contact tube to the base metal (electrode stick out), but voltage has an effect on arc length while welding
- Distance or arc length is directly related to the heat of the arc
  - Lengthening the arc results in hotter arc and a wider, more flat bead
  - Shortening the arc results in a cooler arc and a narrower, more built up bead

GMAW Distance

- Voltage has the most effect on the length of the arc
- The electrode stick out for short circuit GMAW should be about 1/4”- 1/2”. For pulsed and spray transfer GMAW, the stick-out is more
- Electrode stick out is related to arc voltage
  - Too much stick out will result in a narrow, ropey bead, and may affect shielding gas coverage
  - Too little stick out will result in a wide, flat bead
- There are arc control settings on most GMAW welders that can also affect the arc length, such as:
  - inductance in short circuit or spray GMAW
  - trim or arc control in pulsed GMAW

Angle

- There are two types of angles that deal with welding
- **Work angle** is the angle of the electrode in relation to the weld joint
- **Travel angle** is the angle of the electrode in relation to the direction of travel
- Work angles should be adjusted so that there are equal amounts of weld metal on either side of the joint
- Work angles are typically 90 degrees or 45 degrees depending on the joint design and position
- Travel angles typically range 0-30 degrees and can be either a push or drag angle depending on the welding process and position
  - Push angle: top of electrode or torch is tipped away from the direction of travel
  - Drag angle: top of electrode or torch is tipped toward the direction of travel
- Work and travel angles directly affect penetration
  - Work angles off center will result in shallow penetration and the weld metal will penetrate off center of the joint
  - Travel angles too low will result in shallow penetration and risk slag inclusions in SMAW

GMAW Angle

- Travel angles for GMAW typically range 0-30 degrees depending on joint type and position
- Use of a drag or push angle is dependent on the preference of the welder, or specification on a procedure
- Drag angles provide a ropey appearance, but deliver slightly better penetration
- Push angles provide a smoother bead appearance and are usually preferred

Speed

- Travel speed directly affects penetration and is measured in inches per minute
- Travel speed required is dependent on the electrode type and diameter, joint type and position, and the size of the desired weld; or is specified on a procedure
- **Watch the puddle** to determine travel speed
- Maintain a speed that effectively melts the base metal to the desired depth of penetration and adds weld metal to the desired size
- If the ripple pattern is long and the bead is narrow, the travel speed may be too fast.
- If the bead is wide and paired with undercut or overlap, the travel speed may be too slow.

Manipulation

- There are many ways in which an electrode can be manipulated
- Welding a straight stringer bead, using little or no manipulation, is ideal
- Unnecessary or improper manipulation techniques may result in:
  - Uneven or excessive heat distribution
  - Uneven penetration
  - Slag inclusions (FCAW)
- Weaving is a very common manipulation technique
- Weaving is used to make bigger welds, usually as a cover pass on top of stringer beads
- Weaving is typically used welding in the vertical position
- Weaving in the horizontal or overhead position is not recommended (think gravity!)

Sixth Basic

Comfort!

- An essential component not usually talked about, but absolutely necessary in producing good welds
- If you are not comfortable while welding, it will show in your weld bead
- Position your body in relation to the weld joint so that you can see the puddle and are comfortable the entire time while traveling across the joint
- Relax, take a deep breath, and go!

Five Basics to Good Welds – SMAW

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2. Distance (arc length/wire stick-out)
3. Angle (work and travel)
4. Speed (travel speed)
5. Manipulation

Welder Heat Settings

- How a welder is set is imperative to a good weld
- Observe welder settings charts based on material thickness, electrode type, and electrode diameter
- SMAW welders use amperage settings

SMAW Heat Settings

- Set amperage with SMAW based on the type and diameter of the electrode, the thickness of the base metal, and the joint position
- If there is excessive spatter and/or undercut with a flat bead, the amperage may be too high
- If the electrode is difficult to start and the bead is narrow, high, and/or ropey in appearance, the amperage may be too low

Distance

- Distance refers to the arc length while welding
- With SMAW, this means the distance from the electrode's core wire to the base metal
- Distance or arc length is directly related to the heat of the arc
  - Lengthening the arc results in hotter arc and a wider, more flat bead
  - Shortening the arc results in a cooler arc and a narrower, more built up bead

SMAW Distance

- The distance from the electrode's core wire to the base metal should be the same as the diameter of the electrode
  - 1/8" electrode = 1/8" distance (arc length)
- With some SMAW electrodes, the core wire burns faster than the flux, making the actual distance longer than it appears
- If there is excessive spatter and/or undercut with a flat bead, the distance may be too long
- If the weld bead is small, high, and/or ropey in appearance, the distance may be too short

Angle

There are two types of angles that deal with welding

- Work angle is the angle of the electrode in relation to the weld joint
- Travel angle is the angle of the electrode in relation to the direction of travel